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LIFE HISTORY OF *ELYMNIAS AGONDAS GLAUCOPIS* (NYMPHALIDAE: SATYRINAE), A PEST OF OIL PALM IN PAPUA NEW GUINEA

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ABSTRACT. The early stages of *Elymnias agondas glaucopis* Staudinger in Papua New Guinea are described and illustrated. This species has transferred from native palms to introduced species, such as the oil palm (*Elaeis guineensis* Jacq.), and has become a minor pest. The average length of life cycle on palms and bananas was 48 days (n = 9) at an ambient temperature of 27°C. Two species of *Brachymeria* (Hymenoptera: Chalcididae) were recorded as parasitoids of the pupae.

Additional key words: *Elaeis guineensis*, parasitism, natural enemies.

Elymnias agondas glaucopis Staudinger (Nymphalidae) (Figs. 1–3) is a medium-sized nymphalid butterfly that occurs in northeastern Papua New Guinea. Throughout its geographical range, the larvae utilize native palms as larval host plants. Following the introduction of the oil palm (*Elaeis guineensis* Jacq., Palmae) to Papua New Guinea, *E. agondas glaucopis* began using this species as well. As a consequence, *E. agondas glaucopis* currently is considered a minor pest of oil palm in Papua New Guinea. This story closely parallels one in Malaysia where *Elymnias hypermnestra* Fruhstorfer transferred from native species [e.g., *Areca* and *Cyrtostachys* (both Palmae) and *Bambusa* (Graminae)] to oil palm and coconut (*Cocos nucifera* L., Palmae) (Lepesme 1947).

The early stages of *Elymnias agondas australiana* Fruhstorfer were described briefly by Wood (1984). In this paper I describe the early stages of *E. agondas glaucopis* for the first time and report color differences between the larvae of these two subspecies. I also report on larval survival on various food plants and identify predators and parasitoids of *E. agondas glaucopis*.

MATERIALS AND METHODS

I collected larvae, pupae, and females of *E. agondas glaucopis* at the National Botanic Gardens in Lae, Morobe Province, Papua New Guinea, in July 1986, and at the Papua New Guinea University of Technology, 10 km away from the Botanic Gardens, from July 1986 to June 1987. From May to July 1988, adults were netted in flight or trapped at fermenting banana bait at the Papua New Guinea University of Technology. Larvae and pupae discovered in the field were reared in the

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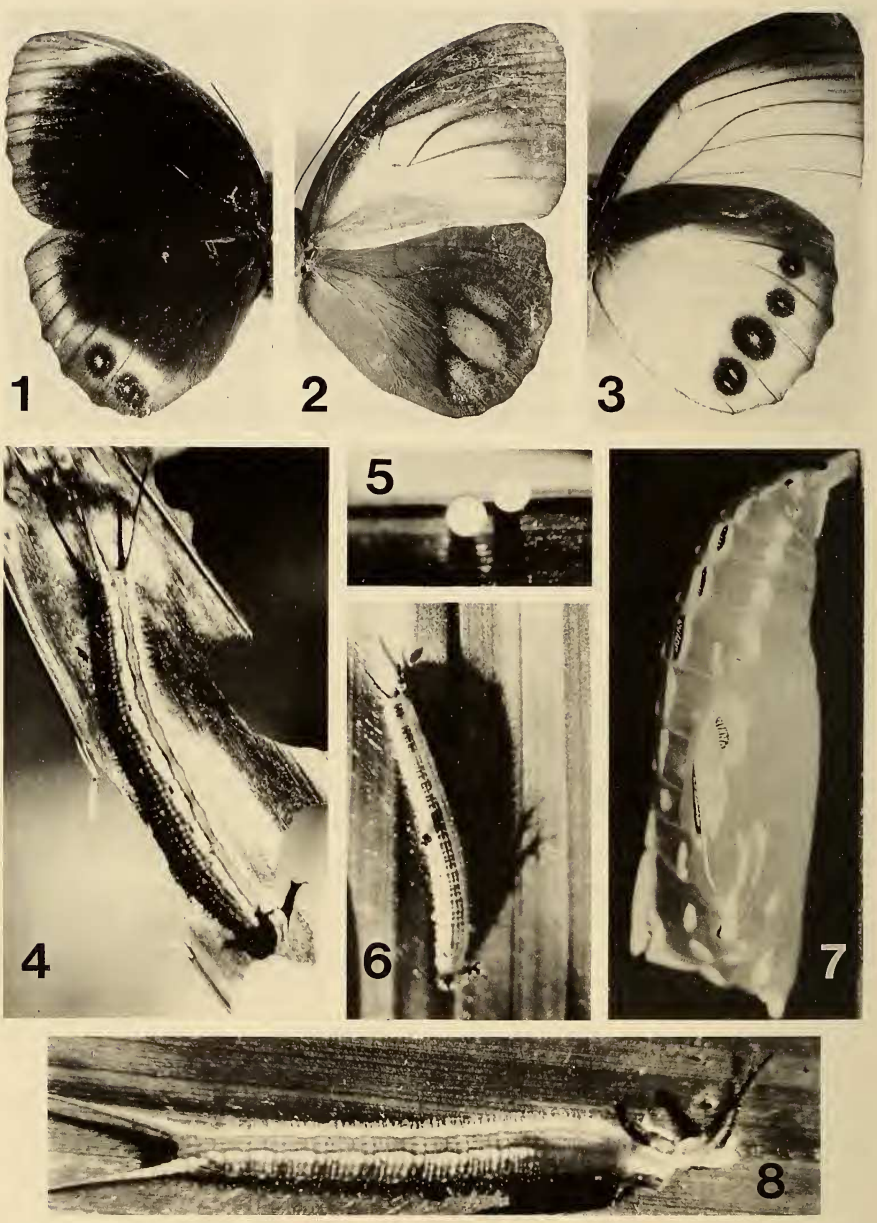

FIGS. 1–8. *Elymnias agondas glaucopis*. **1**, Upperside of male; **2**, Upperside of female; **3**, Underside of female; **4**, Third instar larvae; **5**, Eggs; **6**, Second instar larva; **7**, Pupa; **8**, Fifth instar larva eating shed exuvium.

laboratory or sleeved on foodplants outdoors to obtain parasitoids and adult butterflies. Reared and field collected females were used to obtain eggs to assess larval survival on various hosts, and to obtain eggs, larvae, and pupae for descriptions of the early stages.

During the 1988 season, the rearing protocol was as follows. As first instars hatched, they were transferred to cut leaves in glass jars. Larvae were offered one of the following: betel-nut (*Areca catechu* L.), coconut (*Cocos nucifera*, Palmae), cycad (*Cycas circinalis* L., Cycadales), or banana (*Musa acuminata* Colla and *M. balbisiana* Colla, Musaceae). Not more than six larvae were confined per jar.

Parasitoids that emerged from field collected larvae and pupae, and predators of larvae observed on sleeved foodplants, were recorded and sent to the Commonwealth Agricultural Bureau International Institute of Entomology, London, for identification. Specimens of the larvae and pupae of *E. agondas glaucopis* are deposited in the Natural History Museum, London (voucher nos. BMNH ES 3238–3244).

Descriptions of the early stages are composite, based on all eggs, larvae, and pupae either collected in the field or obtained via reared females. Because larval size varied with age, nutritional state, and hydration, a range is provided for all measurements in the descriptions below. Where possible, healthy larvae were used for the descriptions. Measurements of length of larvae do not include the anal processes.

RESULTS

Early Stages

Egg (Fig. 5). Oblate spheroid, ca. 1.5 mm in diameter; pearl white when laid; chorion darkening slightly before hatching; surface smooth when observed with hand lens (×10). Laid singly or occasionally in pairs on upper surface, or more commonly, on under surface of leaf.

First instar. Newly hatched larva whitish, with shiny, light brown head. Head armed with ten stout black spines tipped with white. Paired dorso-lateral posterior spines subsequently develop into horns. Head and body covered with white hairs terminating in glandular tip. Anal segment produced dorsally into two green processes, each 1.0 mm in length and bearing a white-tipped black spine. Length of larvae increases from about 4.0 mm (n = 45) to 6.5 mm (n = 35).

Second instar (Fig. 6). Head with two dark brown palmate horns, each bearing five black spines tipped with white; two dark brown stripes extend across frons, appearing continuous with horns. Two dark brown spines on either side of the head and four black warts posterior and ventral to horns. Body green, paler below; two longitudinal yellow lines outlining dorsal vessel, which appears darker green. Paired thick yellow

lines dorso-laterally and laterally; faint yellow line below spiracles. Spiracles yellow. Anal processes black, terminating in spines with white distal bulbs; processes united at base by black bar. Short white hairs arise from raised tubercles. Length of larvae increases from about 7.5 mm (n = 4) to 12.5 m (n = 2).

Third instar (Fig. 4). Head with four pairs of upward-curving light brown spines laterally. Body with yellow dorso-lateral stripes mixed with orange and blue-green; blue-green lacking on segments 11 and 12. Dorso-lateral lines running into pink anal processes tipped with black on segments 11 and 12. Anal processes yellow in *E. agondas australiana* (Wood 1984). Length of larvae increases from about 15 mm (n = 4) to 22 mm (n = 1).

Fourth instar. Head with irregular white creamy patches and black spines from light brown pedicels. Base of horns knobby. Body with two thick dorso-lateral longitudinal lines subdivided into six yellow compartments on each segment, second to fourth compartments with orange patches (brightest in third) surrounding central hair. Fifth compartment with elongate blue-green spot. Spiracles brown, linked by wavy yellow lines. Anal processes pink, 6 mm long. Length of larvae increases from about 24 mm (n = 4) to 29 mm (n = 4).

Fifth instar (Fig. 8). Head about 4.3 mm in width (n = 6; measured from shed skins), with horns and accompanying spines black; lateral spines light brown tipped with black. White spots near antero-lateral stripes and jaws, as reported for *E. agondas australiana* (Wood 1984). Prothorax with two dorsal yellow spots. Anal processes pink; yellow in *E. agondas australiana* (Wood 1984). Spiracles orange-yellow. Length of larvae increases from about 31 mm (n = 1) to 40 mm (n = 1).

Pupa (Fig. 7). Apple green, becoming paler with age. Head with two anteriorly directed yellow horns marked with black; horns in *E. agondas australiana* black and white (Wood 1984). Dorsal mid-line centered with pink, interrupted, running from small swelling on prothorax to cremaster. Dorsal line turns 90° at posterior end of mesothorax. Wing cases marked with yellow, pink, and black concentric circles and lenticular patches. Costa of forewing outlined with yellow and pink. Cremaster yellow with three black dots. Body is bent so that it is held parallel to substrate. Length 22–27 mm, width 8 mm (n = 5).

Eggs held at 27°C hatched in five to seven days. Each larval stage, from first through fourth instar, ended with a day or two of inactivity as a pharate larva. First and fourth instar typically lasted about 5 days; second and third instar typically lasted about 6 days. A day or two was spent as a pharate pupa, indicated by a swollen and yellowish prothorax. The total length of the life cycle varied between 44 days (on narrow leaved *Ptychosperma* sp.) and 51 days (on banana—*Musa acuminata*

TABLE 1. Foodplants of *Elymnias agondas glaucopis* in Papua New Guinea (PNG). All supported complete development from first instar, where noted.

Species	Area native to	Evidence of potential use by *E. agondas*
Brassiophoenix schumanii	PNG	7 larvae and 1 pupa found in field.
Caryota rumphiana	PNG	2 larvae and 1 pupa found in field.
Chrysalidocarpus lutescens	Madagascar	1 egg laid in field—completed development.
Cocos nucifera	PNG	P. Clark (pers. comm.). 1 larva completed development.
Cycas circinalis	PNG	1 pupa found in field.
Elaeis guineensis	W. Africa	R. Prior (pers. comm.). 1 larva completed development.
Musa acuminata & *balbisiana*	PNG	3 larvae completed development.
Ptychosperma spp.	PNG	5 larvae and 2 pupae found in field. 2 larvae completed development.
Roystonea regia	Cuba	1 larva and 2 pupae found in field.

and *M. balbisiana*). These findings agree with those of Wood (1984), who reported 5 days for the egg stage and 49 days for the total life cycle of *E. agondas australiana*.

Foodplants

Larvae of *E. agondas glaucopis* completed development on a variety of palms, both native and introduced (Table 1). Larvae and pupae were collected in the wild from *B. schumanii*, *C. rumphiana*, narrow leaved *Ptychosperma* sp., and *R. regia*. A single egg was collected from *C. lutescens*, and a parasitized pupae was found on *C. circinalis*. In the Higaturu oil palm plantations in the Northern Province of Papua New Guinea, *Elymnias agondas glaucopis* is abundant, utilizing oil palm as the larval hostplant (R. Prior pers. comm.). It also utilized *C. nucifera* in the wild (P. Clark pers. comm.). In captivity, *E. agondas glaucopis* successfully developed on *Chrysalidocarpus lutescens*. Wood (1984) obtained oviposition of *E. agondas australiana* on *Calamus caryotoides*.

First instar larvae of *E. agondas glaucopis* fed on all plant species offered: *Areca catechu*, *Areca* sp., *Cocos nucifera*, *Cycas circinnalis*, *Musa acuminata*, and *M. balbisiana*. However, all larvae reared confined with *Areca catechu* (n = 25), *Areca* sp. (n = 2), and *Cycas* (n = 6) died before completing development. Of 20 first instar larvae confined with *Areca catechu* and two confined with *Areca* sp., 16 died before the next ecdysis. Of five fifth instar larvae transferred to *Areca catechu*, only one resulted in a pupa, and it was deformed. Some individuals had deformities following ecdysis to the fourth instar, particularly of the horns and anal processes. Of 14 larvae confined with

Cocos nucifera, only one reached adulthood; two larvae reared on coconut had shortened anal processes. Of four larvae confined with banana leaves (*Musa acuminata* and *M. balbisiana*) throughout, three survived to adulthood. Of seven larvae transferred to cut coconut and banana leaves from a defoliated potted oil palm, two completed development on coconut and two on banana.

Natural Enemies

Of twelve pupae collected in the wild, four (33%) were parasitized by *Brachymeria* nr. *jambolana* Gahan and one (8%) by *Brachymeria* nr. *lasus* (Walker) (Hymenoptera: Chalcidoidea). Larvae sleeved outdoors in 1988 were attacked by immature *Pristhesancus femoralis* Horvath (Heteroptera: Reduviidae) and *Montrouzeriellus melacanthus* (Boisduval) (Heteroptera: Pentatomidae). Debris and spider mites (Acarina: Tetranychidae) were observed sticking to the glandular hairs of fourth and fifth instar larvae. The hairs may function as a defense against some predators and parasitoids.

Both larvae and adults were preyed upon by house geckos (*Hemidactylus frenatus* Dumeril and Bibron; Sauria: Gekkonidae). Predation upon adults may be reduced owing to mimicry. Female *E. agondas glaucopis* are believed to be Batesian mimics of unpalatable *Taenaris* species (Nymphalidae: Amathusiinae) and *Euploea* species (Nymphalidae: Danainae) (Fruhstorfer 1913, Parsons 1984). Within the study area, *Taenaris catops* Westwood (n = 2) were observed imbibing sap exuded from the trunk of a damaged cycad. This behavior is similar to the pharmacophagy exhibited by adult Danainae (Parsons 1984) and may confer a degree of unpalatability to this species. *Euploea* species are believed to sequester toxic glycosides and alkaloids from their hosts. Male *E. agondas glaucopis* may be Batesian mimics of *Taenaris onolaus* Kirsch. The latter is assumed to be unpalatable to predators owing to its foodplant, *Cycas circinalis*, which is known to be toxic to livestock (Hooper 1978, Henty 1980). It is interesting to note that adult *Taenaris onolaus* were ignored by geckos under situations similar to those where *E. agondas* were eaten.

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